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Quantitative assessment of reentrainment in the electrocyclone*

The paper was devoted to the investigation of the reentrainment which was a parasitic effect incipient at the gas-cleaning systems – cyclones. It was demonstrated that the reentrainment arises at the speed of the aerosol from 14 to 27 m/sec. The quantitative characteristics of the reentrainment were determined.

Key words: the investigation of the reentrainment; cyclones; gas-cleaning systems; irrigation receiving electrode.

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Introduction

The dust materials suppression at the chemical factories is the actual task [1]. The problem of the fine purification of the large gas volume from the disperse particles was existed. At present the applied multileaf lamellar electrostatic filters are too expensive, bulky and don't ensure the required high purification efficiency to 99.5–97 %. The wet gas cleaning at the emulsifiers troubles the utilization of the product since its release from the pulp and the following drying is requested. The large heat costs are necessary for this. Also the task of the elaboration of the high-performance equipment for the cleaning of the large gas volumes (hundred of thousands m³/hour) with the receipt of the product in the dry form is actual [2].

The reentrainment by the dust collecting is the parasitic fact. It depends on the material dispersion, the gas stream speed, the electrode voltage, the design philosophy of the materials and other. The identification of the efficiency dependence of the work of the electrocyclones from mentioned factors represents the scientific and practical interest [3].

Early it was shown [4] experimentally that the gas purification efficiency decreases at the aerosol increasing speed above 15–17 m/sec on the entrance to the electrocyclone. The centrifugal force is increasing at the increasing of the gas speed in the active zone that favors to the precipitation of the particles but at the constant length of the machine the time of the aerosol stay is decreasing, the effi-

ciency of the charging of the particles is down, the ash Ola increases. It's result of that the particles don't have time to settle on the receiving electrode. The reentrain-

ment is increasing because the already settled particles especially small knocked out of the sediment layer of large particles and turbulent eddies.

Experiment part

You want to exclude one of the factors to assess the degree of influence of the residence time of the gas flow in apparatus factor and the reentrainment on the decrease in the efficiency of particle collection in the electrocyclone. To exclude secondary reentrainment is necessary to irrigate the receiving electrode by film of water (wet mode). Then the particles that touched the water film will not be able to go back into the gas stream, and will be permanently removed from the active zone. Experiments were conducted in dry and wet mode of operation of the electrocyclone.

For research was used an laboratory experimental setup (stand), shown in fig. 1. The stand included the electrocyclone 1, palpatation 2, tranporter TNZh 3, the high voltage source (model IVNR-20-10) 4, a U-shaped tube to determine the hydraulic resistance of the electrocyclone 5, the filter bag 6, inlet pipe to the collector 7, valves 8, rotameters 9, the pressure gauge 10,

the filter holder (type IRA-20-2) 11, the sampling tube 12.

The test material was supplied by palpatation 2 in a disaggregated form on the inlet pipe 7 into the electrocyclone 1. Caught ash was collected in the hopper of the electrocyclone 1, and the purified air in the duct was removed through the bag filter 6 into the atmosphere.

For experiments with irrigation described above, the electrocyclone was supplemented with irrigation system and removal of the pulp (fig. 2).

For irrigation receiving electrode of the electrocyclone 1 used located in the cochlea of the irrigation system, consisting of a distribution of ring 2 and the feed tube 3. The slurry from the hopper 4 is removed through the seal 5 in Montego 6. The uniform irrigation of the wall at the translational-rotational motion of the gas was achieved when water flow was 8 l/min.

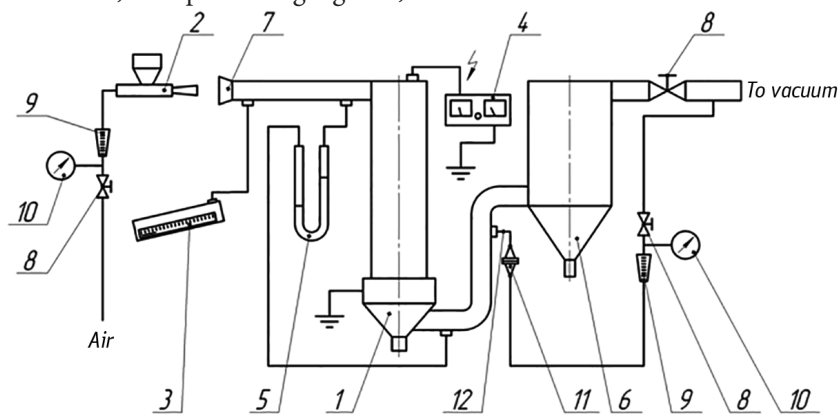


Fig. 1. Scheme of the experimental setup

Results and Discussion

In the experiments on the capture of ash in the wet mode the reentrainment has been completely eliminated, however, the observed incomplete capture of ash, which can be explained by nagasarete particles and active turbulent mixing flow.

The amount of ablation can imagine $(1 - n) \cdot 100\%$ what allowed us to estimate the values of ablation in terms of purity. The dependence of entrainment speed at a fixed concentration of ash 16.5 g/m^3 are shown in fig. 3.

From figure 3 it is seen that in wet mode at $U = 17 \text{ kV}$ (electrocyclone mode) carryover is less than 1 %, lowering the voltage to $U = 0 \text{ kV}$ (cyclone mode) ash reaches 5–7 %, whereas the ash in dry mode, when $U = 17 \text{ kV}$ matter 12–25 %.

According to the experiment were also calculated values of the secondary ash as the difference between the degree of cleaning in wet and dry mode for corresponding points of the plan. The dependence of secondary reentrainment from the input speed and concentration of ash is shown in fig. 4.

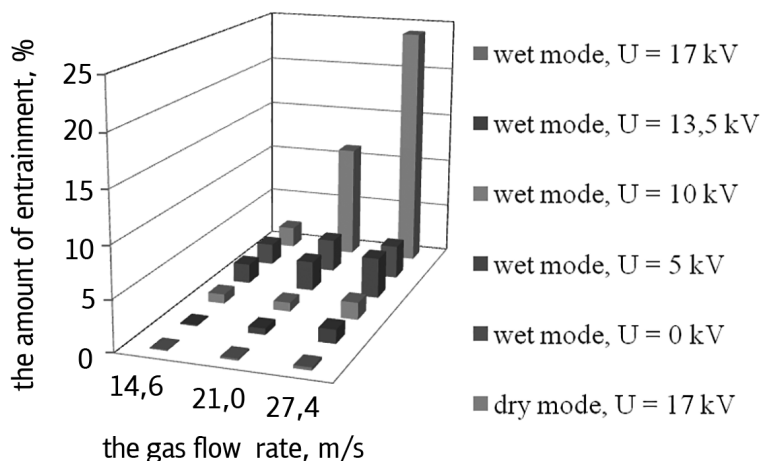


Fig. 3. The dependence of the amount of entrainment from the gas flow rate at different operating conditions of the electrocyclone

From Fig. 4 shows that reentrainment varies in the interval from 5 to 35 %, the highest values are observed at gas velocities of more than 21 m/sec. The average value of the secondary ash is 10–15 %, which is significantly higher than the entrainment caused by necessarily. Thus, reentrainment reduces the efficiency of ash

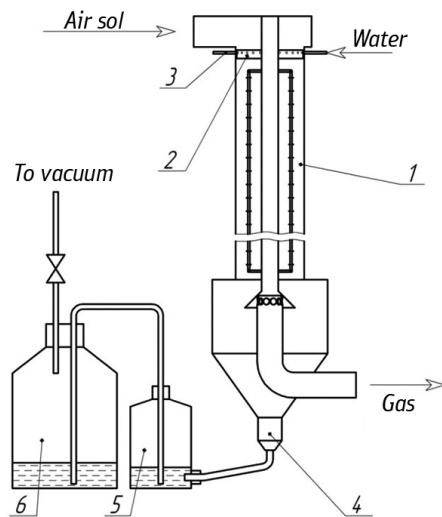


Fig. 2. Diagram of the cyclone to work in wet mode. Indicate in the figure: 1 – electrocyclone, 2 – distribution ring, 3 – feed tube, 4 – bunker, 5 – seal 6 – Montagu

in the electrocyclone at 5–35 % at velocities of aerosol 14.6–27.4 m/sec, respectively, by increasing the ablation is 10–50 times.

Conclusions

The reentrainment is observed in the electrocyclone at a critical velocity of the aerosol at the inlet over 14–16 m/sec, which depends on the concentration and properties of the dust.

The reentrainment is almost completely eliminated by irrigation receiving electrode film of water. The degree of purification is above 95 % without applying a voltage to the corona electrode and above 99 % at a supply voltage of 17 kV to the corona electrode.

Due to a secondary ablation of the degree of purification is reduced by 5–30 %.

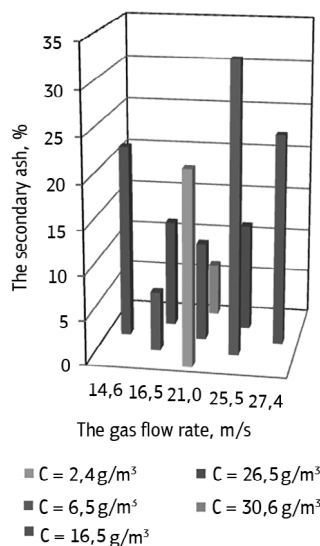


Fig. 4. The dependence of secondary ash at various initial concentrations of ash in the gas stream in the dry mode of operation of the cyclone from the gas flow rate at different operating conditions of the electrocyclone

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